

A Conceptual Study of Fetal Nourishment

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ABSTRACT

In Ayurveda, the child in the womb is known as garbha. The way that the garbha is nourished is explained in a very clear way from the very delicate stage to the gradual development. It has made it impossible to understand many Ayurveda principles. The purpose of this investigation was to compare the Ayurveda knowledge of fetal nutrition mechanisms with modern science. Literature related to fetal nutrition was collected from various Ayurveda classics, contemporary literature, and recent research articles from 2008 to 2020 by using PubMed, Google Scholar, Research Gate, etc. Ten research articles related to the mechanism of fetal nutrition, the manner of distribution of nutrients, nourishment according to Ayurveda, and the modern aspect of fetal nourishment were included. From the stage of the fertilized egg to its full-term delivery, Rasa-dhatu is the source of nourishment. Before organogenesis, the embryo is nourished by the mechanisms of upasneha (filtration) and upasveda (filtration/secretion). Innovative research studies on the nutrient transformation from mother to embryo have confirmed that the initial mechanism of nutrient transformation is histotrophic through uterine tissue secretions. It aligns with the upasneha and upasveda mechanisms proposed in Ayurveda. After organogenesis, the fetoplacental circulation gets established and nutrition becomes haematrophic, which is similar to the description of the nutrition of the fetus via garbha nabhi nadi and rasavaha dhamani. These blood vessels could be explained by kedari kulya nyaya. The other tissue nutrition theories like ksheera dadhi nyaya, khale kapota nyaya, eka kala dhatu poshana nyaya can be applied to understand the various mechanisms of tissue nourishment in intrauterine life as well as postnatal life. Accordingly, it can be clearly understood that the fetal nutrition theories described in both medical philosophy are much similar. In Ayurveda, garbha poshana vidhi have been mentioned under Garbhaniparicharya and the responsibility of educating the society is primarily responsible to us.

Keywords: *Fetal nutrition, garbha poshana, fetal circulation, nourishment*

INTRODUCTION

Background of the Research

The creation of the human body takes place during the development of the fetus.

Pitta (fire or heat), Sleshma (lunar principles of the body), corporeal Vayu, the three main characteristics of Sattva, Rajas, and Tamas (adhesion, cohesion, and

disintegration), the five organs of sense, and the Self (Karma-Purusha) are the protectors of the life (Prana) of the foetus. (Murthy, 1911)[5] According to Ayurvedic concepts, one factor that establishes a person's identity is *Prakriti* (temperaments). There are seven types of temperaments. Its connection is caused by two or three derangement of doshas of the body joined together. And the character of a man is determined by the predominance of particular doshas in his progeny (the actual combination of sperm and ovum) and the predominance doshas give rise to various special characteristics. It causes various physical symptoms in individuals. (Murthy, 1911)[6]

For the creation of a human being, the process of *shukra* (sperms) and *sonata* (ovum) combination is very important. The reason is that the health of the spermatozoa and their nature directly affects the newly born life. The male reproductive element (*Shukra*) has somaguna (thermolytic properties) while the female element presents the opposite quality of *Arthava* and is therefore *agniguna* (thermogenic properties). The principles of *prutvi*, *apo*, *thejo*, *vayo*, and *akasha* are also present in men in their subtle forms and contribute to the formation of the material parts by their molecular adjustment in the way of supplying nutrition and in way of adding to their bulk. (Murthy, 1911)[7]

According to the *samhithas* the purpose of the nutrient is mentioned as it is. The food ingested by the mother containing all the six *rasas* and four types of food undergoes metabolism. The derived cream part is

divided into three parts. One part of *rasa* is facilitating the growth of the mother (*Sva-sharira-pushtyarth*). Another part of *rasa* is assisted in the growth of the embryo (*Garbha vridhyarth*). The other part of the *rasa* is assisted in the growth of the breast and the formation of breast milk. (Usha V. N. K., 2015)[16]

Aim and objectives

- To understand the Ayurveda concept the human body is nourished in the fetus.
- To comparison of Ayurveda nutritional theories and modern nutritional theories.
- To reveal that the fetal nutrition theories mentioned in Ayurveda are scientific.

Methodology

The conceptual study of fetal nourishment elicits from various classics and articles. Mainly used *Charaka samhitha*, *Susrutha samhitha* as primary data books. As secondary data, electronic databases including PubMed Scopus, Google Scholar, and Journals were explored. Data were collected only from 11 journal articles published from 2012 to 2022. Observed 25 journal articles, but infant nourishment, nourishment after the delivery, *garbhani paricharya* were excluded. Only fetal nourishment, *garbhaposhana*, *garbha sharira*, the mechanism of fetal nutrition, the manner of distribution of nutrients, nourishment according to Ayurveda, and the modern aspect of fetal nourishment included were included. Language restriction was performed and English articles were included.

Fetal Development According to Ayurveda Philosophy

Different Ayurveda physicians mentioned their opinion on fetal body development as these, *Shaunaka* says that probably the head of the fetus is first developed since the head is the only organ that makes the functions of all other organs possible. Since the heart is the seat of Manah and Buddhi—the mind and intellect—Kritavirya asserts that the heart is the first organ to develop. The son of *Parashara* says that a fetus gets its nourishment from the mother's body through the umbilical cord, and the development of the umbilical region of the fetus must be taken the first place. *Markandeya* says that the arms and legs of the fetus develop first because they are the only means of movement in the womb. *Shubhuti Gautama* says that during the early development of the trunk, all other limbs and organs are created according to the information embedded in relation to that part of the body. *Dhanvantari* holds that the growth of all the corridor of the body of an embryo goes on contemporaneously, and they can not be sensed or detected in their earlier stages of growth in the womb owing to their extremely downgraded size like a mango fruit or sprouts of bamboo. As the gravestone, gist, pith, etc. of a ripe and progressed mango- fruit or the sprouts of bamboo, can not be independently perceived in the before stage of their growth but are relatively distinguishable in the course of their development, likewise in the early stage of gestation the branches and organs of the body(fetus) aren't distinguishable for their extremely downgraded stage but come potent(and

thus they're distinctly perceived) with time for their development. (Murthy, 1911)[8]

According to the *Susrutha Acharya* fetal development explain as follows. In the first month of gestation a gelatinous substance is only formed (in the womb); the molecules of the primary elements such as, *Panchamahabhuta*—*vayu* (air), *agni* (fire), *prithvi* (earth), *apo* (water), and *akasha* (ether) being acted upon by cold (*Kapha*), heat (*Pitta*) and air (*Vatha* or nerve-force) are condensed in the second month. A lump- suchlike appearance(of that confused matter) indicates the manly sex(of the embryo). An elongated- suchlike shape of the matter denotes that the fetus belongs to the contrary sex; whereas its excrescence suchlike shape(like a Shalmali- bud) predicts the absence of any sex(i.e. a hermaphrodite). In the third month, five lump- suchlike protrusions appear at the places where the five organs videlicet the two hands, two legs, and the head would be and the minor limbs and members of the body are formed in the shape of extremely small papillae.

In the fourth month, all the limbs and organs (of the body of the embryo) come more potent and the fetus is endowed with cognizance owing to the conformation of the viscus of the heart. As the heart is the seat of cognizance, so as the heart becomes concentrated, it's endowed with consciousness and hence it expresses its desire for effects of taste, smell, etc. (through the jones of its mother). The enceinte is called double- hearted (*Dauhrida*) at the time, whose pleasantries and solicitations not being recognized and gratified lead to the birth of a

paralyzed, hump-backed, crooked-fortified, lame, dwarfed, disfigurement-eyed, and blind child. Hence the solicitations of the enceinte should be gratified, which would insure the birth of a strong, vigorous, and long-lived son. (Murthy, 1911)[9] A physician should beget the jones of a pregnant woman (Dauhrida) to be gratified in as important as similar delectation would palliate the discomforts of gestation, her solicitations being fulfilled insure the birth of a strong, long-lived, and righteous son. Anon-fulfillment of her solicitations during gestation proves pernicious both to her child and herself. Anon-gratification of any voluptuous enjoyment by its mother during gestation tends to sorrowfully affect the particular sense organ of the child.

The foetus acquires a mind (Manah) in the fifth month and awakens from the dream state of its subconscious reality. In the sixth month cognition (*Buddhi*) comes in. In the seventh month, all the branches and components of its body are more markedly developed. The *Ojo-dhatu* (in the heart of the fetus) doesn't remain muted in the eighth month. A child born at that time (the eighth month) dies for want of *Ojo-dhatu* soon after its birth, a fact which may be inversely credited to the agency of the malignant monstrosities. Hence (in the eighth month of gestation) immolations of meat should be made to the demons and monsters for the secure continuance of the child). The delivery takes place either in the ninth, tenth, eleventh, or twelfth month of generality, else commodity wrong with the fetus should be restrained. (Murthy, 1911).[9]

The umbilical cord (*nabhi nadi*) of the fetus is set up to be attached to the cavity of the vein or artery of its maternal portion through which the substance of lymph-chyle (*Rasa*) produced from the assimilated food of the mother, enters into its organism and fastens its growth and development, (a actuality which may be understood from the analogy of percolation or transudation of blood). Incontinently after the completion of the process of fecundation, the vessels (*Dhamani*) of its maternal body which transport the lymph-chyle (*Rasa*) and sprint laterally and longitudinally in all directions through it, tend to foster the fetus with their transudation each through its continuance in the womb. (Murthy, 1911).[10]

Nutritional Methods Mentioned in Ayurveda Classics

Before the fetal body parts aren't distinguishable it gets nourishment by absorbing moistness and by osmosis. After the body parts get observable, a part of the nutrition is admitted by permeation through the pores of skin positioned in the hair roots of the body and the umbilical cord. The fetal umbilicus is attached to the umbilical cord, umbilical cord to the placenta. The placenta is attached to the mother's heart. Blood is injected into the placenta through percolating blood arteries by the mother's heart. Due to its inclusion of all necessary components, this nutrition promotes strength and complexion. (Chethan Kumar V.K., 2017) According to *Charaka samhitha*, *Rasa* is the responsible for proper growth of the fetus. Live cannot be sustained without the intervention of

the *Rasa*. The manifestation and growth of the body, vitality of life, continuity of strength, satisfaction, and enthusiasm are derived from the *Rasa*. (Patwardhan K., Upadhyaya W., 2020)[12] Therefore, it is very important to transport the *Rasa* to the fetus. According to Ayurveda *Samhita* texts, circulation of *Rasa* occurs by *Apara nirmana purva poshana (Upasneha, upasweda prayukta)*, *Apara nirmana anantara poshana (Garbha nadi prayukta)*. According to Vagbhata, the nutrition enters the foetus' Pakwashaya (digestive system) through the umbilical chord, where it is metabolised and provided with food by the foetus' own Kayagni (digestive fire). 2017's Chethan Kumar V.K.[2]

Apara Purva Poshana (Upasneha, Upasweda Prayukta)

According to the different classics it has been mentioned as from conception until parts and sub-parts are distinctly demarcated the life of the fetus maintain by the nutrition supplied by the *rasa* carrying *dhamanis* of the mother spread with ramification by process of diffusion (*upasneha*). The *upasneha* (perfusion, osmosis, active and passive transport) and *upasweda* (warmth) from the mother as a result of the passage of time and own nature fetus obtain growth and development in the uterus. (Gehlot S., 2020)

Upasneha has *snigdha guna* and *Upasweda* has *uthkeleda guna*. Both of these provide nourishment to the fetus. (Usha V. N. K., 2015)

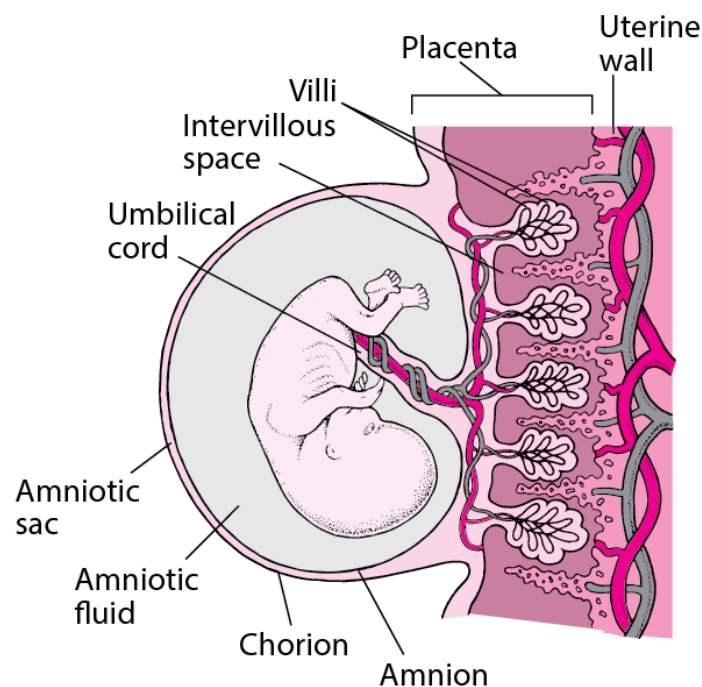


Fig. 1: The mechanism of Upasweda poshana theory.

And in addition to this, *Upasneha, Upasweda* in *Charaka Samhita* has been

given another etymology. According to that, the fetus is free from thirst and

hunger. It is dependent upon the mother for all its activities. The manifested and non-manifested organs get aliment through the proceeding of *upasneha* (perfusion) and *upasweda* (thermal regulation). It gets nourishment by the process of perfusion- sometimes through the hair follicles and sometimes through the umbilical cord. According to the *Acharyas*, *Upasneha* is like a tree being nourished by a lake full of water. (Bhalerao S., 2020).[1]

In the foremost stages, *Kapha* is more predominant in *Garbha*. So, for the nourishment of *Kapha*, *Kapha Vardhaka Ahara* is necessitous. *Guru, Snigdha*, etc. *Ahara* which improves *Kapha* in the body can not pass through the frail pores. So, for that another separate process “*Upasneha*” has been mentioned by *Acharyas*. (Kumar H., and Kaur H., 2017).[4]

Apara Nirmana Anantara Poshana (Garbha Nadi Prayukta)

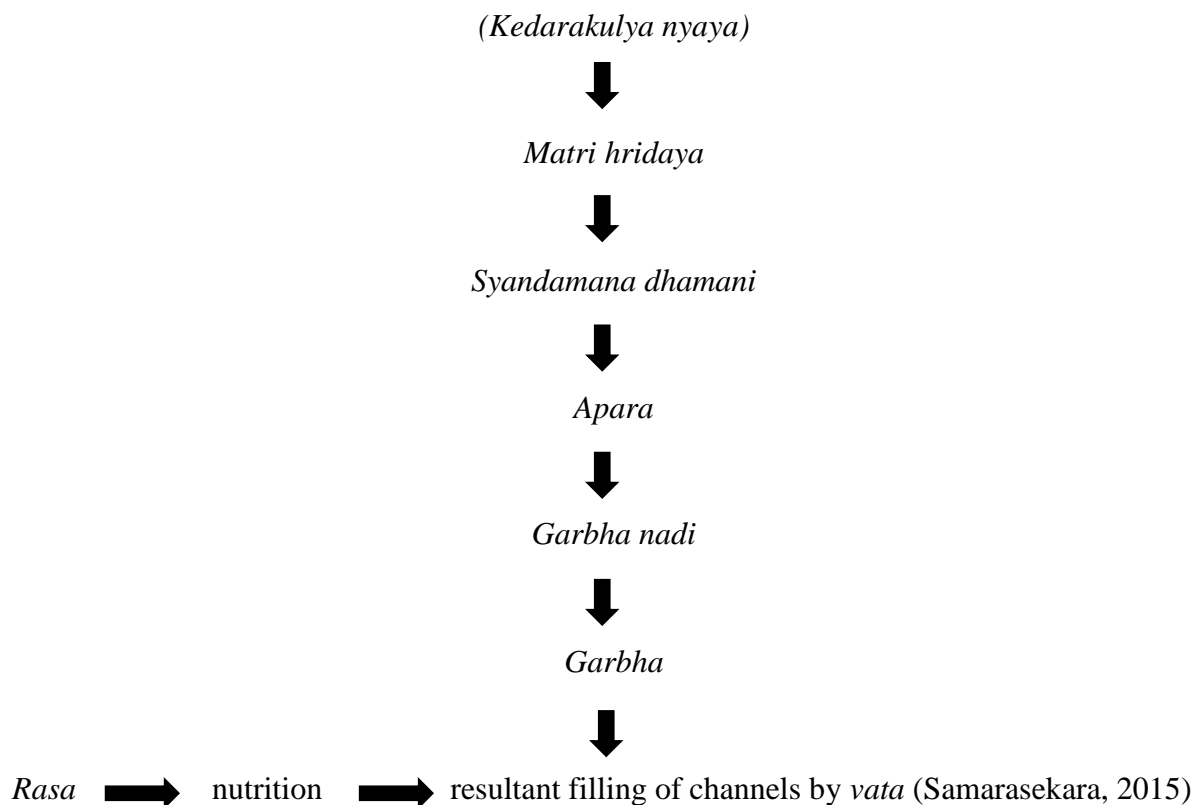
When all organs and parts of the fetus become well developed, *garbha nadi*, which is a tube-like structure connects the umbilicus of the fetus with *apara* (Placenta) of the mother. The umbilical cord of the fetus is attached to the umbilicus on one end and the placenta on the other end. The placenta is in turn connected with the heart (circulatory system) of the mother. The heart of the mother alluvions the placenta (with nourishment) through the pulsing vessels. This *Rasa* (nutritional fluid) promotes the strength and complexion of the fetus as it's formulated of a material having all six

Rasa (tastes). The nutrient portion of *rasa* goes to *Pakwashaya* of the fetus where it undergoes further digestion.

Rasa (digestive product of food) of the pregnant woman serves three purposes viz. Nourishment of her own body, lactation, and growth of the fetus. Being supported by that food, the fetus that is dependent upon the mother keeps living inside (the uterus). (Bhalerao S., 2020).[3]

Ayurveda is said that nourishing through the navel is done according to the *Kedarikulya nyaya*.

According to that *Kedarikulyanyaya* can be defined as these, *Kedari (kyari)* means field (paddy field) and *kulya* in this reference denotes a small canal. The technique is used in the process of irrigation where the water from the reservoir is supplied to small fields through canals. In *kulya* (canals) the movement of water takes place in the direction of gravitational force. The water reaches the first part of the field and after that, it reaches the alternate part of the field by pressure grade process (when the first *kedari* is filled with water then water shifts to the ensuing *kedari*). It explains the passive diffusion of particles across the cell membrane. This process probably explains the importance of pressure gradient which determines the flow of fluid into the tissue spaces. It explains the passive diffusion of particles across the cell membrane along the concentration gradient because the water in the above example passes into different fields passively along the direction of the concentration gradient.



Transmission Process According to Modern Concepts

- Simple diffusion
- Facilitated diffusion
- Active transport
- Bulk transport
- Organelle transport
- Breaks in placental villi

Factors Regulating the Placental Transfer

- The concentration of the substances in the maternal plasma
- The rate of maternal blood flow through the intervillous space
- The area available for exchange across the villous trophoblast epithelium
- The physical properties of the tissue barrier
- The concentration of the substance in fetal blood

Fetal Nourishment Described in Modern Physiology

According to modern science after fertilization, till the implantation blastocyst receives nutrition partially from the substance repositied within the ovum and partially by diffusion from the uterine concealment. When the blastocyst moves towards the uterine cavity, a large number of secretions formed by the secretory cells of the fallopian tubes provide nutrition. Once it reaches the uterus it gets implanted.

The developing fetus gets its nutrition from the secretions of the endometrium or yolk sac before the formation of the placenta and thereafter from the umbilical vessels attached to the placenta. Now various researchers have suggested that in all mammalian species, nutrition of the conceptus is initially histiotrophic, with

the trophoectoderm phagocytosing first oviductal and then uterine secretions called uterine milk. The uterine milk contains glycoprotein and amino acid that nourishes the embryo. The uterine glands are a significant source of nutrition during organogenesis, when metabolism is largely anaerobic, according to research.

After implantation decidua or endometrium of the pregnant uterus provides nutrition. The gland show marked dilatation and increased tortuosity and increased secretory activity. The endometrial stromal cells contain extra quantities of glycogen, protein, lipids, and

minerals necessary for the conceptus. From 8th week onwards gradually it is taken up by the placenta. (Chethan Kumar V.K., 2017)[2] The circulation system of the mother is not directly connected to the fetus. The circulation of the nutrients from the mother is done by two circulations. Such as placental circulation, and fetal circulation. Placental circulation of blood in two systems there is uteroplacental circulation and fetal-placental circulation. Nutrient materials from the uteroplacental circulation ooze out to the fetus-placental circulation at the capillary level in the placenta.

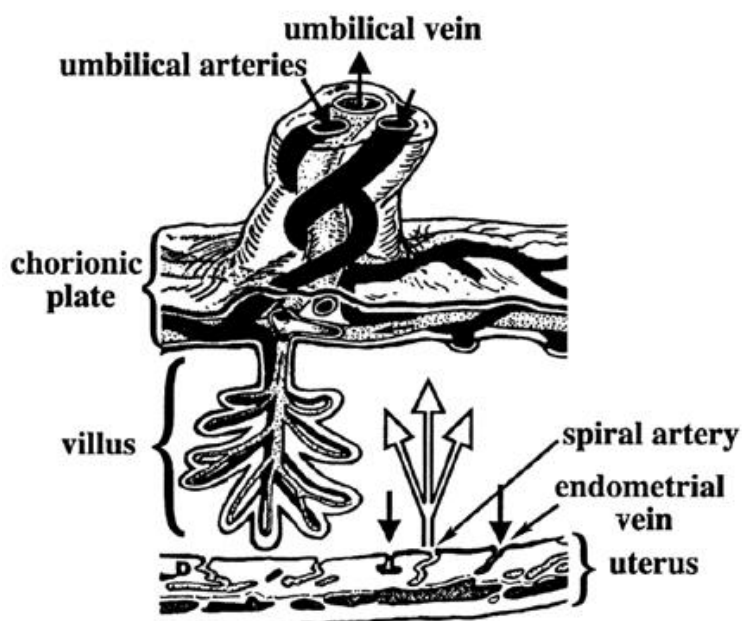


Fig. 2: Placental transformation.

The blood influx through the placenta. Fetal structures are labeled on the left and contain the umbilical arteries and umbilical vein, chorionic plate, and villus. Maternal blood enters the intervillous space through the spiral arteries and exits via the endometrial veins. (Peter V.D., *et al.*, 2008)[13]

The placenta functions as the respiratory center for the fetus. As well as it functions as filtration for plasma nutrients and wastes. Oxygen-free voluntary diffusion of substances such as water, glucose, amino acids, vitamins, and inorganic salts through the placenta. Uterine arteries

supply oxygenated blood, which permeates the sponge-like material there. The chorionic villus, an alveolus-like structure, and the umbilical vein both receive oxygen diffusion from the placenta. The uteroplacental blood flow is increased during pregnancy from 50cc/min (at 10 weeks) to 500-600 cc/min. The ratio of uterine blood flow to the placenta is not exactly known. But then in late pregnancy, the placenta receives 90% of the total flow. The villi are the only part of the placenta which is to circulate maternal and fetal blood flow. The maternal blood flows around the vascular structure while the fetal blood flows into the inner part. The maternal blood of the spiral arteries flows into a system of communicating interstices that encircles the cotyledons: intervillous space, maternal capillary wall, the stroma of the intervillous space, and syncytiotrophoblast. (Usha V. N. K., 2015)

Fetal circulation is carried out in a closed vascular system where the average pressure is about 30 mm Hg, which is much higher than that seen in the intervillous space where it is about 10 mm Hg. The pressure difference prevents the collapse of the villous vessels. (Pansky. B., 1982)[11]

Oxygen and the nourishing substances of the maternal blood are exchanged with the fetal blood and simultaneously the products of the fetal metabolism are acquired. Then maternal blood flows into the vein of the basal plate. Each villous tree depends on its spiral artery although the intervillous space is a system rather open, the disposition of the villi and the gradient of pressure are linked so that the perfusion depends closely on the original

placement of the flows. In case of occlusion of the spiral artery, it would be caused to death of the tissue of the cotyledon that is used to feed.

In this way, the nutritional remains of the mother are transferred to the child. Where 90% of oxygenated blood passes through the umbilical vein to the fetal free margin of the falciform ligament of the liver. It is then connected to the heart of the fetus through 3 blood vessels. One of them is connected to the inferior vena cava by the ductus venosus. This nourishes the heart of the fetus and it nourishes the whole body. (Usha V. N. K., 2015)

This is why the nutrition of a pregnant mother is very important. This is mentioned in detail in the books like *Charaka Samhita*, *Susruta Samhita*, *Ashtangahridaya Samhita* and *Kasyapa Samhita*, etc. under *Garbhani paricharya*. (Sonam. A., et al., 2020)[15]

DISCUSSION

All the *Acharyas* have explained that the nutrition of the fetus occurs in two ways, in the stage of *Asanjatha anga awadhi* and in the stage of *Sanjatha anga awadhi*. Accordingly, in the stage of *Asanjatha anga awadhi*, the fetus is nourished by the *upasneha* mechanism, and in the stage of *Sanjatha anga awadhi*, the uterus is nourished by the *upasveda* mechanism. The *upasveda* mechanism begins with the creation of *Aparā* and in Ayurveda, it is explained in detail that the creation of *Aparā* is created by a part of the menstrual blood that collects due to the blockage of the woman's menstrual arteries. (Murthy, 1911)[10]

And as the *Bhoja Acharya* mentions, blood that accumulates in this way is forbidden. It is shown that *nabhi nadi* is also created by the *ahara rasa* of mother's food. *Aparava* is connected to the umbilical cord of the fetus by the umbilical cord. It is stated in *Ashtanga Sangraha Indu Tika* that the *ahara rasa* (blood) obtained from the mother goes to the *pakwasa* of the fetus through the umbilical cord and is nourished by the *kayagni* there. Another thing is as indicated by all *Acharyas*, menses have ceased after conception, and admitted that menses accumulate and circulate for the nourishment of the mother, the production of milk, and the nourishment of the fetus. However, the word "*Arthawa*" mentioned in it cannot be considered as the meaning of menstruation or *Rajahsrava*. There are different meanings for the word "*Arthawa*". Some of them are ovum, or *Shoniths*, and *Ambu*, or hormones. Accordingly, *Arthawa* can be

considered a hormone. According to this connection, modern science can also be scientifically explained in terms of reproduction.

After sperm fertilization, the uterine cavity is further prepared for conception. It increases by four times the thickness before pregnancy. (1.5-6.2mm) This process is done by the estrogen hormone. Another phenomenon is the corpus luteum created after ovulation stimulates the uterine function due to the action of progesterone hormone and chorionic gonadotrophic hormone. It also increases the size of blood vessels. As a result, the placenta is created. When the modern opinion and the Ayurveda opinion are considered analytically, the placenta is formed due to the hormonal changes caused by the absence of menstruation. It nourishes the pregnant child. (Samarasekara, 2015)[14]

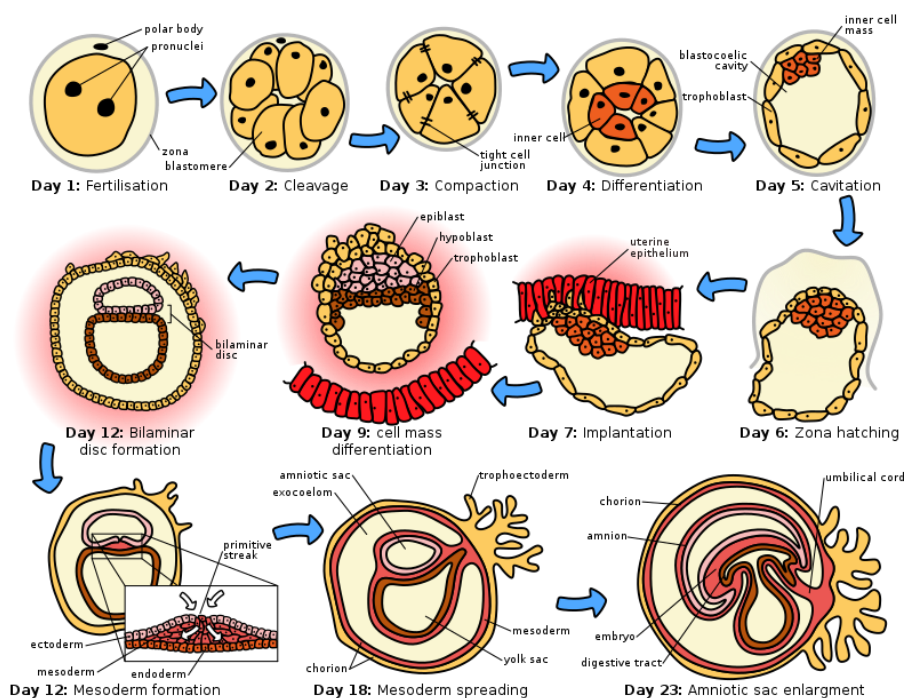


Fig. 3: The initial human embryogenesis with placenta formation.

According to the Ayurvedic perspective, incorrect garbha poshana manifests in the foetus as Upavishtaka, Garbhasrava, Mrutagarbha, and Vikruta garbha all refer to congenital malformations, intrauterine growth restriction, and abortion.

According to the modern description, certain conditions are caused due to improper fetal nourishment. Such as,

IUGR (Intrauterine growth restriction) meant by the maternal cause includes deficiency of critical substrates such as glucose, amino acids, and oxygen to the mother. Placental causes include cases of poor uterine blood flow to the placental site for a long time. This could be because of placental pathologies like Mosaicism, Placenta previa, Abruptio, Circumvallate, and Infarction.

Intrauterine fetal death. It is occurred due to a deficiency of Iron, Folic acid, Vitamin B12, and protein. It will lead to hypoxemia which can lead to fetal death.

Congenital malformation. It is caused by maternal intake of alcohol, drugs, and malnutrition will lead to congenital malformation. To fulfill the optimal nutrition for the fetus and the mother, Ayurveda classics explore *Masanumasika garbhini paricharya*, as an example monthly wise dietary regimen for the pregnant mother. From the first day of conception itself, the pregnant has to have palatable food with the predominance of liquid, sweet, unctuous food processed with appetizing materials. By properly following these regimens, a woman delivers the child possessing good health,

strength, all the good qualities, and long life.

CONCLUSION

After fertilization of the sperm and ovum, the process of cell division is carried out by the *Prakrithi vāta dōsha* in *Garbhashaya* and just after reaching into the uterus, it is nourished by the uterine milk. According to Ayurveda, nutrition is absorbed by *Upasneha* and *Upasveda* theory before the formation of the placenta. When analyzing both these concepts, they are similar to each other. The fine particles circulate using the pressure gradient between intracellular and intercellular. However fetal nourishment is a master important event of the pregnancy and every mother should have known about the specialty of fetal nourishment. And there should be an understanding of how to procure it. In Ayurveda, this has been correctly explained under *Garbhaniparicharya* and we have the responsibility to educate society about this and create a healthy generation of children.

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